Comet Shoemaker-Levy 9, A New Class of Object

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The Comet SL9 has high abundance of sulfur and low abundance of H_2O, CO and nitrogen, but most of the fragments were embedded in circularly symmetric inner comae from July 1993 until late June 1994, implying that there was continuous and weak outgassing activity. It indicates that the comet SL9 is a new class of object which is different from those known comets and asteroids. The main features of SL9 are: 1) low abundance of H_2O, CO and nitrogen; 2) high abundance of sulfur; 3) existence of central coherent body, not swarm of debris; 4) fragile nature; 5) low albedo; 6) containing carbonaceous and silicate material; 7) low-volatile object and 8) inhomogeneous distribution of volatile material in the parent body. The existence of this new class of object - SL9 indicates the variety of the objects in the solar system.

The comet SL9 was obviously a complex body. No gas was ever observed in the comet, despite extreme efforts to detect the usually strong cometary CN line with the ESONTT (West, 1994). Most of the fragments were embedded in circularly symmetric inner comae from July 1993 until June 1994, implying there was continuous and weak outgassirg activity. Here are some points favourable and unfavourable for the viewpoint that the SL9 was a comet.

The evidence that is favourable for that SL9 was a comet is as follows:

- Some of the fragments continued to break up after the tidal disruption of the parent body of SL9, this fragile nature is consistent with other observations of cometary nuclei.
- The existence of persistent, symmetric coma around each fragment, possibly indicating continuous and weak outgassing activity (Weaver et al, 1995).

The evidence that is unfavourable for that SL9 was a comet is as follows:

- There are high abundance of sulfur (S) and low abundance of nitrogen (N), CO and H_2O. After the collision of comet SL9, the UV spectra obtained with the HST by (Noll et al, 1995) identified that the most remarkable result is the large abundance of S-containing molecules, particularly S_2 and CS. The mass of S_2 in their small aperture alone approches the total mass of S they would expect from a 10^{15}g cometary impactor. They expect slightly more S from an asteroid impactor, but the enhancement is by no more a factor of 2. The S/N ratio in the observed debris after impact of SL9 apparently exceeds 100, whereas in any location on Jupiter the most likely value for the S/N ratio is < 0.16 and in a comet the S/N ratio is about 2. Before the collision of comet SL9, no gas ever observed in the comet, despite extreme efforts to detect the usually strong cometary CN lives with the ESONTT (West, 1994). Spectra of the SL9'S fragments from the 3.6meter CFHT and 10meter Keck telescope were obtained to search for gas (OH, CN, N_2^+, CO^+) in the 3000 Å to 4500Å wavelength region by Jun Chen et al, but no evidence for emisson was found (Chen, 1994). The above facts indicate that there were large abundance of S and low abundance of N, CO and H_2O. Oxygen containing molecules (CO, H_2O, SiO and others) were conspicuous by their absence (Noll et al, 1995).
- In addition, according to Chodas and Yeomas (published at DPS meeting on October 31, 1994), SL9 most likely came from the inside, i.e. via the asteroidal belt and
- According to (Rettig et al, 1995), they estimate the characteristic dust grain size of order of 10 to 100 μm and its outflow velocity of 3meters/sec. In cometary outflows measured in other comets, the emitted dust grains leaving the SL9 fragment are unusually large with considerably lower velocities.

From the diversity of the impacts and their observed effects, there were obvious differences between the individual fragment of SL9. Generally, the off-train fragments produced less obvious ejecta patterns than their brightness would expect. It implys the off -train fragments contained more volatile material and were more fragile that the on-train fragments. More volatile material in the off -train fragments could release relatively more dust and increase their observed brightness. It might indicates the inhomogeneous distribution of volatile material in the parent body of SL9.

It indicates the SL9 was different from the known comets which have high abundance of volatile material H_2O, CO, NH_3 and others. The existence of the SL9's comae, implying the continous and weak outgassing activity, was also different from the features of the known asteroids. It has been suggested that the SL9 was an object of a new class (Wang, 1994). The existence of this new class of object indicates the variety of objects in the solar system.

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